AF Acquisition Reform Working Paper:

An Overview of the Air Force Product Development Process

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Working Papers are intended to promote discourse in our acquisition reform activities. As such, working papers reflect the efforts and opinions of the authors and not necessarily the position of the United States Air Force.

The Air Force Product Development Process

This paper provides an overview of the various organizations, stages, and processes involved in the current Air Force product development process. It is intended to provide an understanding of the actors and their roles in the process of developing a product. The description provided here is quite general, and any individual development project may follow a slightly different path.

The description is based on federal, DoD, and Air Force regulations and instructions, published books on the defense acquisition process, material for acquisition training courses from industry and specific companies, interviews and discussions with a wide range of people, and personal experience within the acquisition process.

A. Core Product Development Processes

Air Force product development processes can be separated into six distinct stages: identifying the need, developing the requirements, allocating resources, planning the acquisition, contracting, developing the product and establishing the process to produce it.

Force planning determines which systems are needed. Requirements determine what the new system must do to meet the need. Resource allocation determines the funding for the development effort, given the range of activities and responsibilities of the services. Acquisition planning entails determining how the system will be contracted and creating the plan to develop the system. Contracting entails selecting the contractor to develop the product and specifies the contract conditions. Development turns the ideas, requirements, resources, and plans into a working system that can be produced.

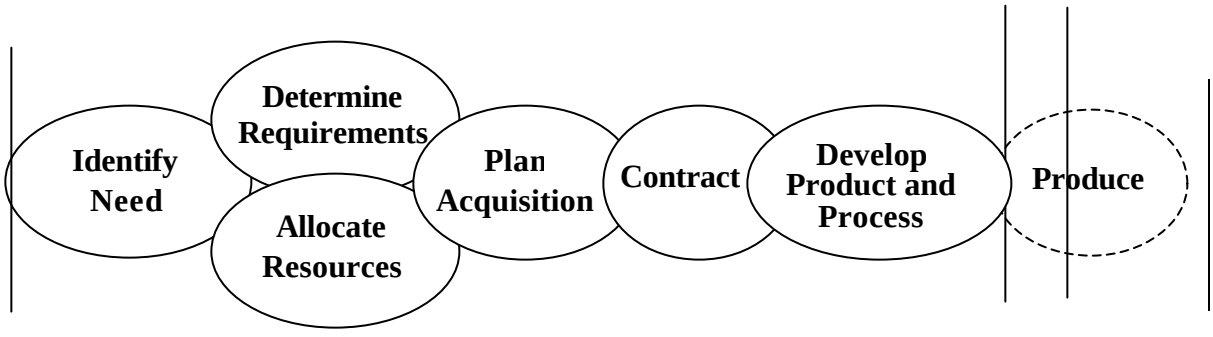

Figure 1: Major Steps in the Air Force Product Development Process.

Identification of need begins when an operational deficiency, an emerging threat, a technological opportunity, or a change in military strategy occurs. Influences at this stage include the Pentagon's long-range planning, the major commands' modernization planning process, and priorities of the senior leadership. A "mission needs statement" specifically identifies the need, which leads to a Milestone 0 decision authorizing further analysis and determination of system requirements. To determine those requirements, the major commands provide an analysis and obtain the Pentagon's approval. The result is an "operational requirements document" outlining what a new system must do.

The major commands' resource planning process and the Pentagon's programming, planning, and budgeting systems identify the dollars, equipment, and number of people authorized for the project. The result is a program objective memorandum and a requested budget sent to Congress. The program offices then develop an acquisition plan and obtain approval within the Pentagon. This results in a Milestone I decision authorizing contracting and development efforts.

A Program Office then produces a request for proposals (RFP) and selects the winning proposal from those submitted by contractors. The result is a contract that describes the specifications for the project and the terms under which the contractor will pursue it.

The contractor then designs both the system and the process used to produce it. The program office oversees this process and the Pentagon oversees the Program Office. Completion of development is marked by delivery of the first production item. Each of these major areas will be described in more detail later in the chapter.

The acquisition process typically proceeds through formal phases and milestones designed to allow for periodic review. Need identification occurs in the Pre-Milestone 0 phase. Setting requirements, allocating resources, and performing early acquisition planning occur during Phase 0. The contracting and the development efforts occur during Phases I and II. The development effort is typically complete by Milestone III or the production decision that marks the beginning of Phase III. Milestone II and Milestone III decisions are administrative-based decisions that do not always tie directly to event-based milestones in the development process. Figure 2 below shows the relationship between the process areas and the milestone phases.

An overall metric of this process is acquisition response time: the time from when the need arises to the time when the system is fielded and ready for use. Development time is the major component of acquisition response time.

Understanding this complex process requires a more detailed look at the organizations and sub-processes involved.

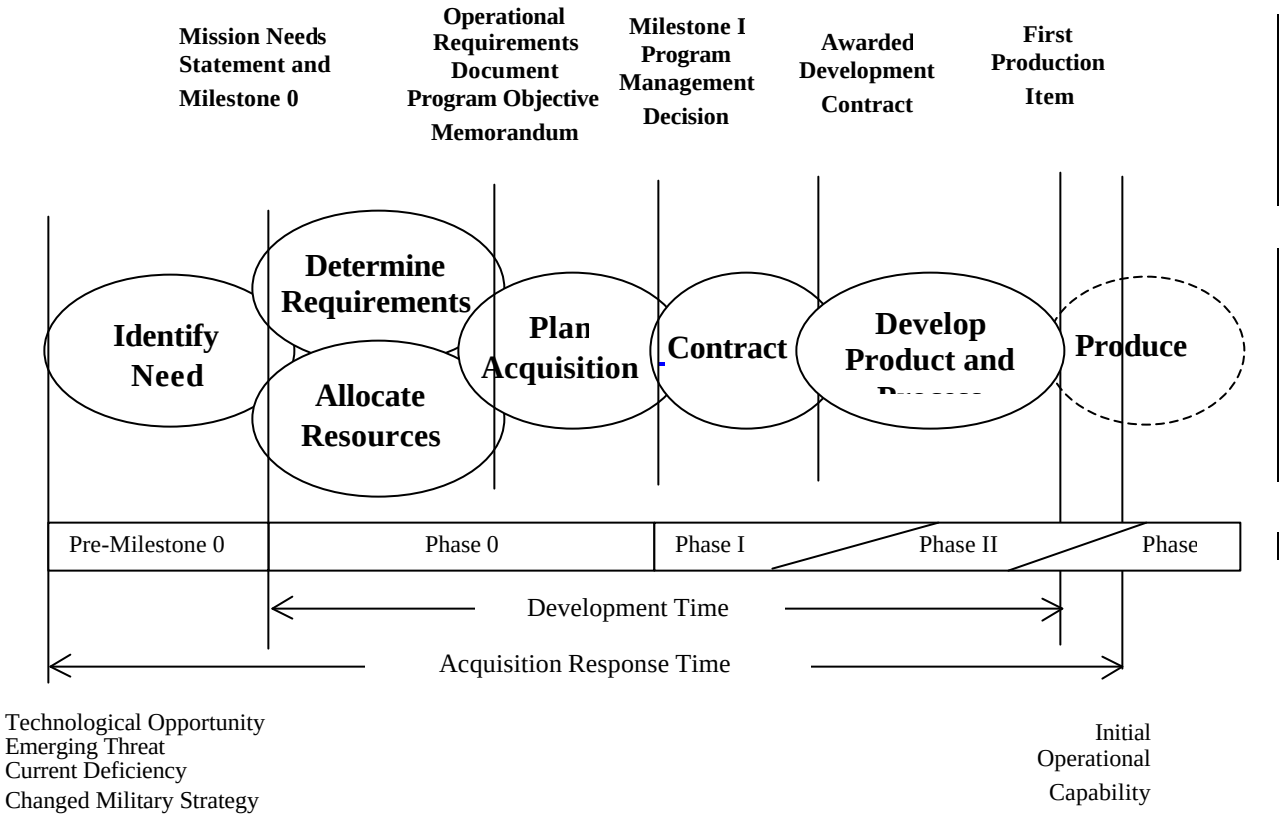

Figure 2: Major Steps in the Air Force Product Development Process.

B. Organizations Involved in Development

The organizations primarily involved in developing defense systems are the users, the service headquarters, the Program Offices, and the defense contractors. Each group plays a different role during various stages, and still more organizations play secondary roles. Figure 3 shows the distribution of various sub-processes by the organizations primarily responsible for them.

The users--the ultimate customers--do much of the planning and establishing of requirements. The users are organized by different Air Force mission areas into major commands such as Air Combat Command (ACC), Air Mobility Command (AMC), and Air Force Space Command (AFSPC); or by geographic area such as US Air Force Europe (USAFE) and Pacific Air Forces (PACAF). A major command's mission is to organize, train, equip, and maintain combat-ready forces for use by the Unified commands, such as US Central Command, which are composed of units of all the services.

Each of the major command headquarters has planning offices that project future needs, requirements officers who identify future requirements for systems, and programming offices that project the budget for major command activities. (These roles will be discussed in detail below.) The officers in these positions are typically from the operational units within the major command.

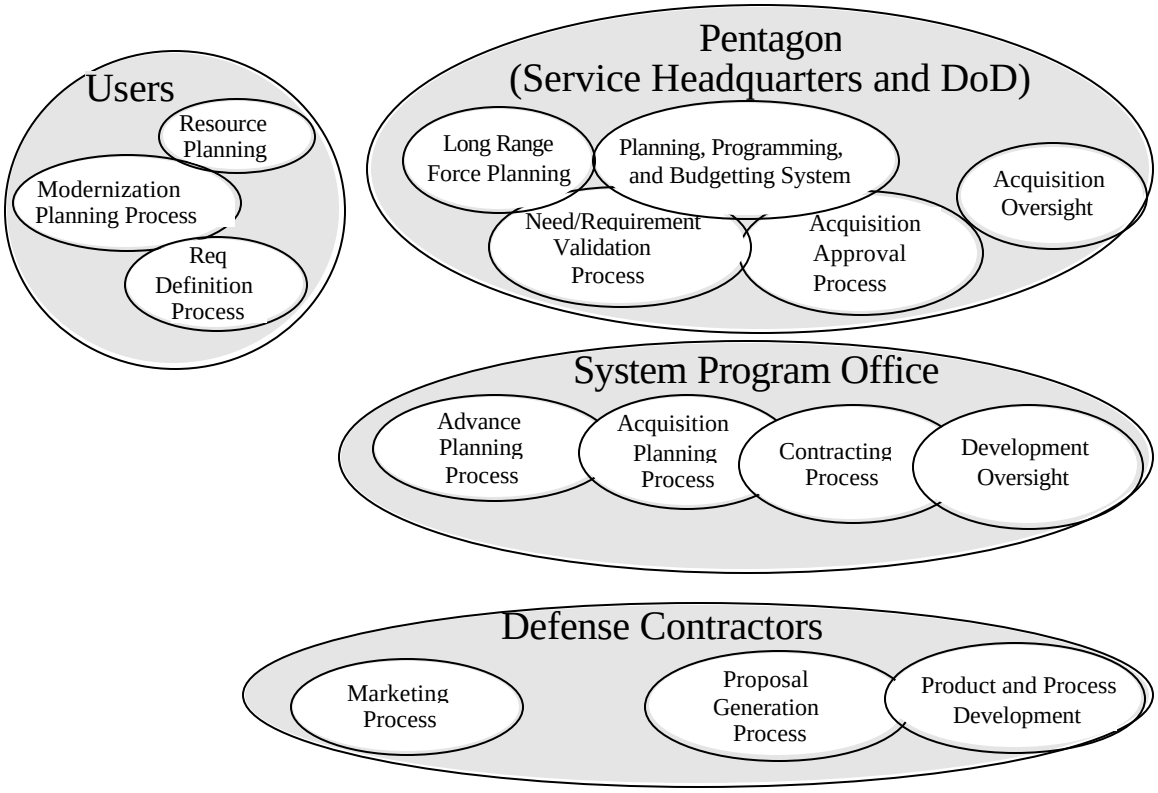

Figure 3: Major Product Development Processes by Organization

The service headquarters and the Department of Defense together compose the Pentagon. Each service headquarters is the approval authority for the planning, requirements generation, and the acquisition plans. They also allocate resources and oversee the various development efforts. Each function is duplicated at the DoD level, with the Office of the Secretary of Defense and the Joint Chiefs of Staff playing an integrating, authorizing, and oversight role. DoD typically becomes involved at this level only with the largest defense acquisition programs and those with joint service application.

Many functional and cross-functional organizations fulfill the service headquarters' role in the development effort. Those organizations are divided between the secretariat and air staff. The key organizations include the Deputy Chief of Staff for Plans and Programs, the Assistant Secretary for Acquisition, the Assistant Secretary for Financial Management, and the Director for Program Integration. Headquarters-level groups such as personnel, manpower, logistics, C4I, and test also become involved through several organizations such as the Working and Overarching Integrated Product Teams and the Requirements Review Councils. These organizations are the primary interface with senior Air Force leaders, DoD, and external organizations such as Congress and the administration.

The System Program Offices oversees planning and contracting for major weapon systems or groups of similar weapons, and act as the primary interface with the contractor community. Program Offices are supported by Development Centers and Logistics Centers, which provide the necessary personnel. Each Program Office typically oversees many product development efforts.

Before developing a new product, defense contractors must win the contract. This involves several organizations within the company: marketing, typically referred to as the business development group; the proposal development team; and the integrated product team, which develops the actual product and processes. Financial management, engineering, and manufacturing groups oversee the company's development efforts.

Many other entities such as the testing community, the defense laboratories, and various defense think tanks also influence a development project but play a secondary role. Higher-level decision makers such as the administration and Congress are primarily involved in funding decisions for major development efforts and typically not in the details.

C. Identification of Needs

In the Air Force, the long-range planning group within headquarters Air Staff, the modernization planning process through the major commands, and an ad hoc process based on direction from senior leadership identify current and future needs. Needs based on current and future threats, military strategy, current military capabilities, and available technology are documented and approved through the mission needs statement, which in turn feeds the requirements and resource-allocation processes.

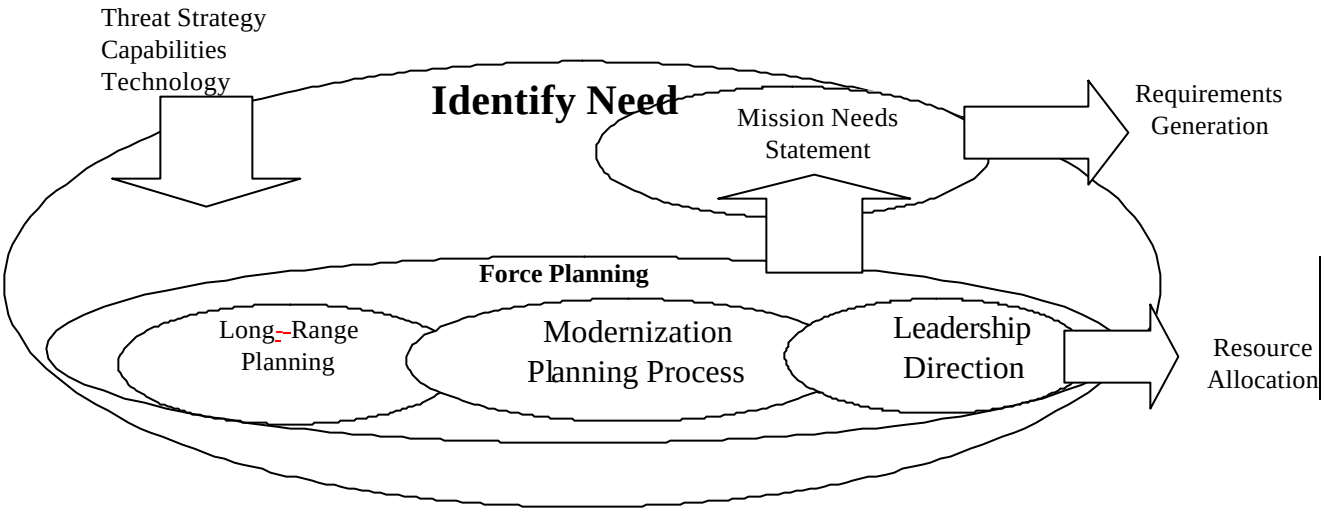

Figure 4: Components of Identifying Needs and Force Planning.

C.1. Long-Range Planning

The Pentagon's Strategic Planning Office was established in 1996 to focus on a 25-40 year time frame. This new organization has not yet had a significant impact on product development but may in the future.

C.2. Air Force Modernization Planning Process

The modernization planning process determines Air Force needs for new or improved capabilities to ensure that the service can accomplish its mission, including the president's national security strategy and national military strategy. The process used to convert the national military strategy into the required weapon systems is referred to as "strategy-to-task." Once the tasks are defined, the planners evaluate the capabilities of existing forces and identifies requirements for new and upgraded systems. This process is referred to as "task-to-need." (The processes used to accomplish the "strategy-to-task" and the "task-to-need" analyses are defined in several documents, including the CJCS MOP 77 *Requirements Generation System Policy and Procedures*, Air Force Directive AFPD 10-14 *Modernization Planning, and Air Force Instruction* AFI 10-1401 *Modernization Planning Documentation*.)

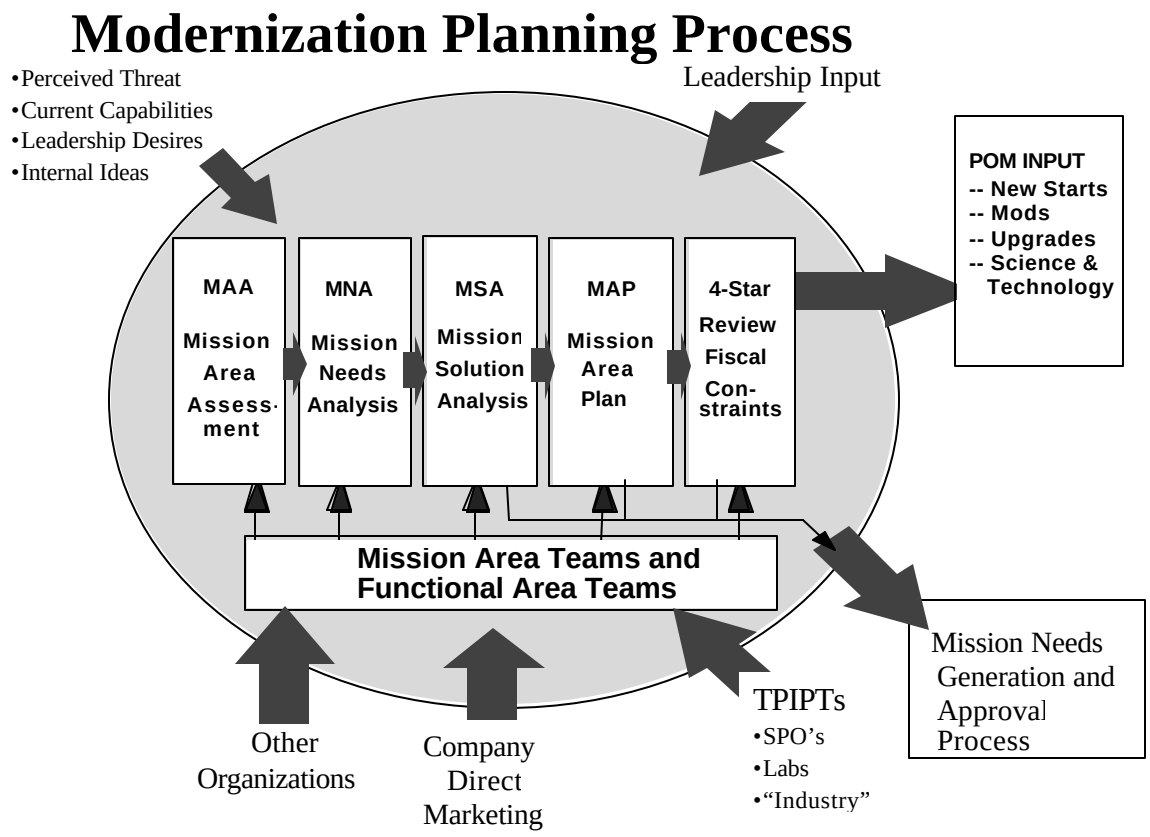

Figure 5: The Modernization Planning Process.

The Air Force modernization planning process is conducted by the major commands through a number of mission area teams and associated technical planning integrated product teams (TPIPTs). These plans project 25 years into the future and guide investments by the scientific, development, and contractor communities. The major commands lead the mission area teams, and the TPIPTs are managed by Air Force Materiel Command and the teams' associated product centers.

Thirty-eight mission area teams and functional area teams analyze capabilities in specific mission areas. One example is the Aerospace Control Mission Area Team, which examines offensive counter-air, defensive counter-air, and theater missile defense. The teams are supported by sub-teams associated with each weapon system, and by technical planning integrated product teams.

The TPIPTs include representatives from Program Offices, defense laboratories, and industry. These teams identify potential systems and concepts to meet needs set by the mission area teams. The TPIPTs also identify future technological needs that direct much Air Force laboratory research.

All these teams follow the "strategy-to-task" and the "task-to-need" processes to determine current capabilities, future deficiencies, and how best to overcome those deficiencies. After estimating potential enemy forces and capabilities for 25 years and projecting Air Force requirements, mission area assessments and needs analysis rely on the national military strategy to determine future needs. Mission solution analysis then determines the major commands' preferred solutions for correcting deficiencies.

Mission Area Assessment (MAA) analyzes the ability of the unified commands and the major commands to undertake their assigned tasks and to fulfill a military contingency plan.

Mission Needs Analysis (MNA) then uses the task-to-need process to determine if existing forces can meet the current and future assigned missions. Identified mission needs are documented in a mission needs statement, which is used to make a Milestone 0 decision for developing any new or modified system.

Mission Solution Analysis (MSA) evaluates potential solutions and produces an "unconstrained set of preferred options."[1] These options may include changes in operations tempo, readiness, training procedures and tactics, modification programs, force structure changes, new acquisitions, and science and technology programs.

Mission Area Plans (MAP) use the results of the mission area assessment and the mission needs analysis to "document the most cost effective means of correcting task deficiencies from among nonmaterial solutions, changes in force structure, system modification or upgrades, science and technology applications, and new acquisitions."[2] The MAPs are roadmaps outlining the modernization plan for each weapon system in the mission area. Functional area plans are developed for cross-cutting areas such as communications.

The modernization planning process culminates with a four-star review by senior Air Force leaders, who approve the mission area and functional area plans. The potential solutions in the MAPs are then "racked and stacked" to determine which will be pursued.

From the finalized MAPs, the major commands develop a prioritized list of new or modified systems. Requirements for new systems and modification of existing systems identified through this process will help determine how much funding each service receives, as well as when the process for establishing specific requirements begins and pre-acquisition planning occurs.

C.3. Leadership-Directed Projects

In a directed project, a senior leader begins a development effort not included in mission area plans. This frequently used top-down process contrasts with the bottom-up process used in modernization planning. Respondents to the surveys conducted as part of this research indicate that 42 percent of current Air Force projects were initiated as the result of leadership direction as opposed to formal modernization planning.[3]

Directed programs may result from a new technology, a highly visible deficiency, or the personal interest of a national or service leader. These directed programs will be incorporated into future mission-area plans for the major commands. A mission needs statement or operational requirement document used for this kind of program often references the senior leader's direction.

C.4. Mission Needs Process

A mission needs statement (MNS) documents the capability required to accomplish a certain operational task, as well as the inability to fulfill the need through training, tactics, or other non-materiel solutions. A validated MNS is required for a Milestone 0 decision, which allows for early studies of alternatives and the operational and cost implications of developing a new system.

Generating the Mission Needs Statement

The major commands write the mission needs statement based on the outcome of the mission needs analysis and mission solution analysis. A major command will also generate a mission needs statement at the direction of senior leaders. Major commands submit the mission needs statement to service headquarters for validation.

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[1] Briefing by HQ USAF/XOXP, AQ/XO Offsite. 1997.
[2] AFI 10-1401 *Modernization Planning Documentation*.
[3] The surveys and responses will be discussed in detail in Chapters 7-11.

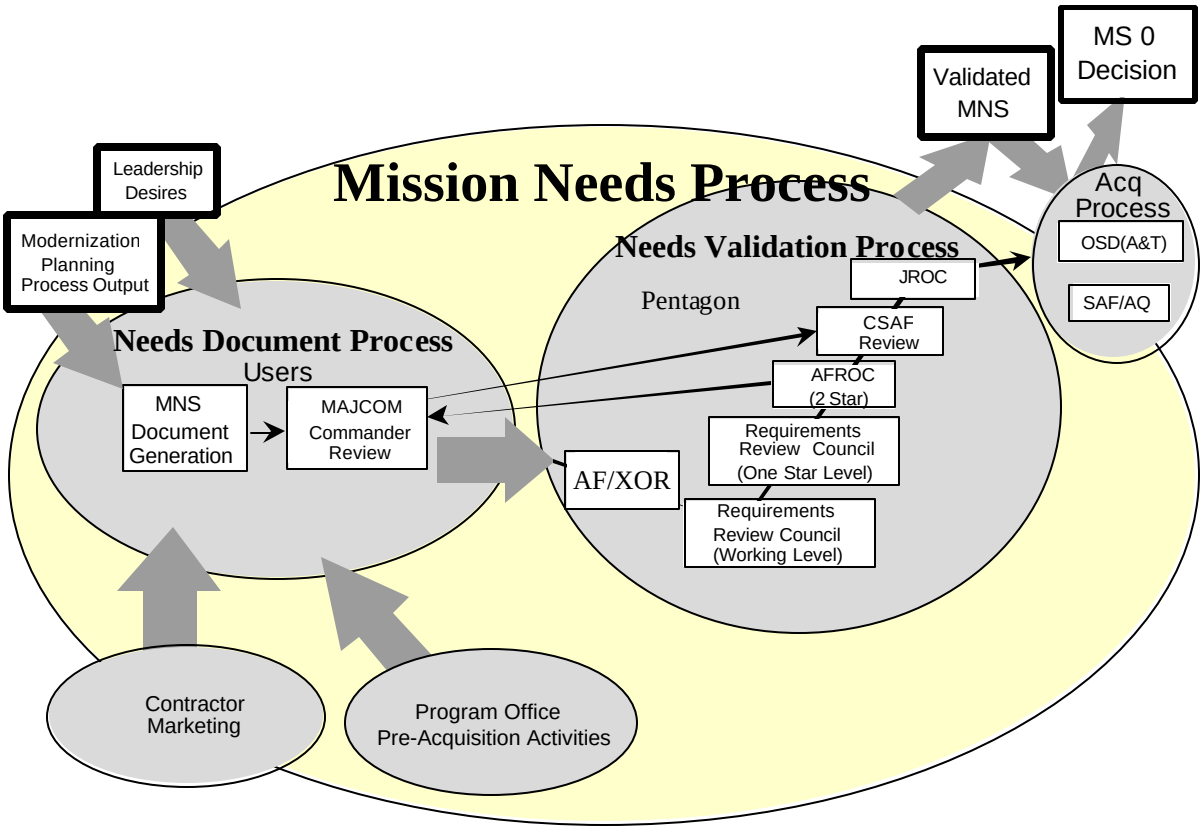

Figure 6: Mission Needs Statement Generation and Validation.

Validating the Mission Needs Statement

The validation process ensures that all operational needs are properly documented and agreed to by various functional groups before any development effort is begun.

A major command forwards a completed MNS to the Operational Requirements Division of the Pentagon, where it is assigned to a requirements action officer who shepherds it through the validation process. This officer submits the MNS to the working level of the Requirements Review Council, which consists of major and lieutenant colonel-level action officers from the functional groups. Following approval at the working level, the MNS is reviewed by the Requirements Review Council, which consists of colonel and brigadier general-level officers from various functional groups. Following council approval, the MNS is then submitted to the Air Force Requirements Oversight Council (AFROC), a two-star-general-level review by the deputy chiefs of staffs.

Once reviewed and approved by the AFROC, the MNS is returned to the major command for final review and signature by the commander. The final document is then sent to the Air Force Chief of Staff for approval and signature. Depending on the size of the potential project or the joint applicability, the MNS may also then be sent to the Joint Requirements Oversight Council (JROC) within the Joint Chiefs of Staff for further validation. The MNS is officially validated by the Air Force Chief of Staff or by the Joint Requirements Oversight Council.

The completed Mission Needs Statement is then sent to the Assistant Secretary of the Air Force for Acquisition, or to the Under Secretary of Defense for Acquisition and Technology. That person makes the Milestone 0 decision to authorize studies of how to best meet the identified need and to define the operational requirement for the new or modified system.

D. Generating and Validating Requirements

Requirements document the capabilities a new system must have to succeed. In practice, there is significant overlap between the process of establishing requirements and the planning activities described earlier. The requirements community consists of groups at the major command headquarters and the Pentagon. Each major command has a director for requirements who is responsible for evaluating current capabilities, identifying deficiencies, and defining the requirements for new systems in operational requirements documents. Within Air Force headquarters, the Operational Requirements Division (HQ AF/ XOR) reviews the documents, coordinates them with other Pentagon organizations, and maintains the library of validated documents. Depending on the project's size and scope or joint service applicability, the document must be validated by the Air Force Chief of Staff, the Air Force Requirements Oversight Council (AFROC) or the Joint Requirements Oversight Council (JROC).

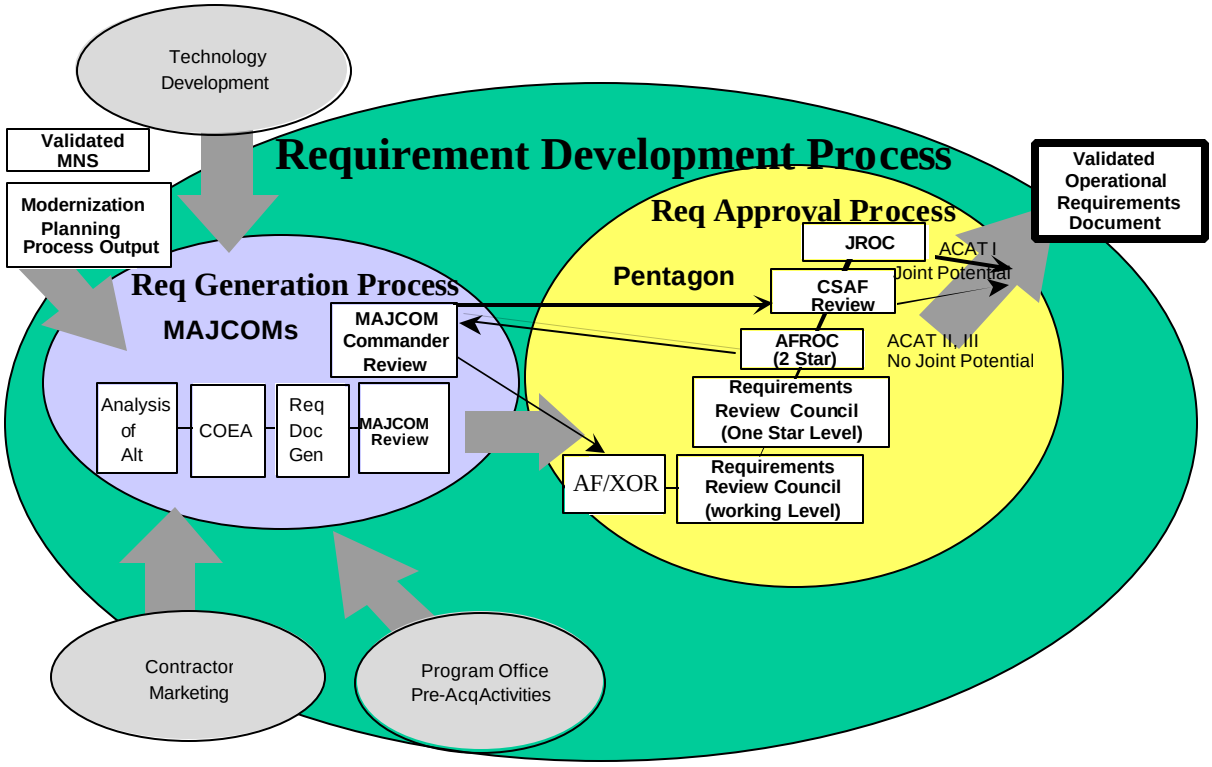

Figure 7: The Process for Generating and Approving Requirements.

D.1. Generating Requirements

Operational deficiencies and solutions are turned into a set of requirements that form the basis of a development effort. When complete, the systems will be tested to determine how well they meet the requirements. The major commands specify requirements by evaluating alternatives, performing Cost and Operational Effectiveness Analyses (COEAs), determining the operating parameters for a specific system, and developing the operational requirements document.

The general characteristics of the desired system are defined by various outputs from modernization planning--often the mission solution analysis--or by directions from senior leadership. The process focuses on how to fulfill the need with the selected system, how the system should work, and what the specific operating characteristics should be. For example, if service leaders have selected a new aircraft to fill a specific need, the requirements will define what the characteristics of the new aircraft must be to fill the need.

The primary steps involved in generating requirements are analyzing alternatives, analyzing cost and operational effectiveness, and generating the operational requirements document.

Analysis of alternatives (AoA) identifies alternative methods of meeting the operational requirements and resolving mission deficiencies following a Milestone 0 decision. The results of these concept studies are used to prepare the cost and operational effectiveness analysis.

Cost and Operational Effectiveness Analysis (COEA) is used to assist decision-makers in selecting the most cost-effective method to fulfill a mission need. The COEA process compares several solutions on the basis of cost and operational effectiveness and documents the rationale for choosing the preferred solution. COEAs are required for all major defense acquisition programs. Formal COEAs are not required and are not typically performed for smaller programs (ACAT II and III).

The Operational Requirements Document (ORD) describes the concept of operations and the specific performance measures—both the minimum and threshold (desired) levels that the new system is to fulfill. If the system cannot meet the threshold parameters, senior leaders must decide whether to continue the project. These key performance parameters are included in the acquisition program baseline and are reviewed as part of the milestone decision points. No acquisition effort can proceed through Milestone I without a validated operational requirements document.

The ORD is updated before full-scale development (Milestone II) and production (Milestone III) to include additional information as the system is further defined. A requirements correlation matrix tracks changes in the requirements over time and documents the reasons for the changes. These and other analyses form the basis for the subsequent acquisition efforts for the system.

D.2. Approving the Requirements

Leaders in the major commands review the ORD, which is then submitted to headquarters and the Requirements Review Council and follows a path similar to that of the Mission Needs Statements. Validating the requirements can take several months to several years, depending on the contentiousness of the issues and the desires of the leadership.

A validated ORD is considered the definitive statement of users' requirements and becomes the technical input into the acquisition process. Once the requirements are established and validated through this process, they cannot be changed without a new review. A validated ORD is required to authorize the start of a formal acquisition process.

E. Allocating Resources

Following the modernization planning process and concurrent with the requirements process, any acquisition effort must successfully negotiate and obtain funding, equipment, and personnel through the resource allocation process. This process is used to develop Air Force and DoD budgets for all activities, and includes the major commands, the Pentagon, DoD, the administration, and Congress. Several different functions are involved, including programming, which authorizes all activities; budgeting, which projects costs and develops annual budget requests; and resource distribution, which disburses and tracks funds once Congress appropriates them. Approved and scheduled funding for development and production is required for the Milestone I decision that authorizes the start of a project.

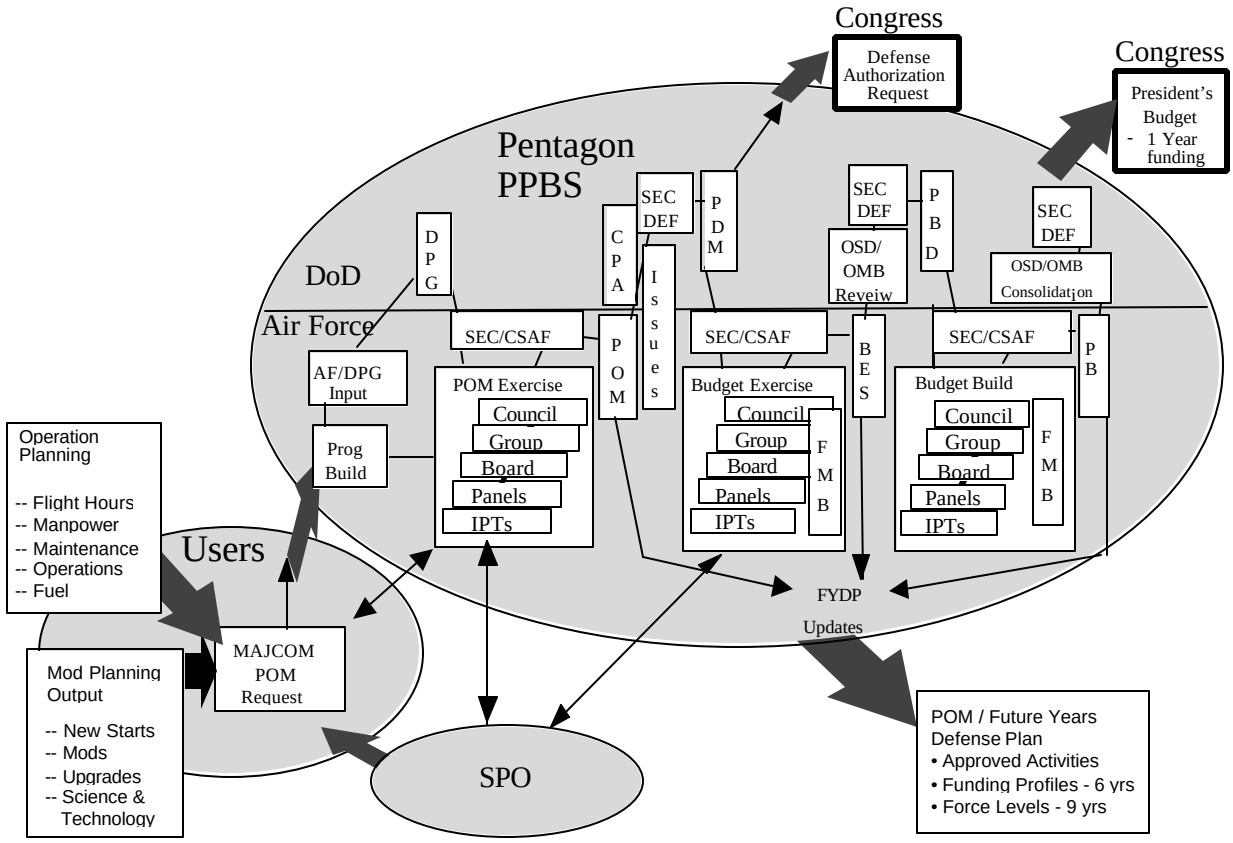

Figure 8: Resource Allocation Processes.

Resource allocation and the Pentagon's planning, programming, and budgeting system (PPBS) include multiple steps over a two-year period. Each major command develops a Program Objective Memorandum (POM), which the Pentagon then uses to develop a POM for each service and the total annual request included in the President's Budget. Once Congress has allocated the money, funds are distributed in accordance with the POM as defined by defense appropriations law.

E.1. Developing the Program Objective Memorandum

Every year each major command projects the resources required to accomplish the missions it must fulfill and to procure the new systems it desires. This information is captured in the Program Objective Memorandum (POM), which covers activities ranging from purchasing fuel and maintaining systems, to developing new products, to training and deploying troops and sustaining existing operations. The POM covers all funding projections for six years and force structure for nine years, and is submitted two years before the first fiscal year to which it pertains. Headquarters for the major command typically develops this document with input from each group within the command. After internal reviews, the commander approves the request and it is forwarded to service headquarters. This document then becomes the initial input to the Pentagon's planning, programming, and budgeting system.

E.2. The Pentagon's Planning, Programming, and Budgeting System

The PPBS is a multi-step annual process used to authorize activities, allocate resources, and develop the service and DoD budgets. Defense Secretary Robert MacNamara began the PPBS system during the 1960s in an attempt to bring focus, coordination, and control to the defense planning and budgeting processes.

Each activity the service undertakes must be covered by a program element, which allocates all funds and resources. The lowest level in the PPBS system, the program element, can represent a single weapon system undergoing development or an ongoing military operation. A program element monitor (PEM) is the official spokesperson for that activity within the Pentagon.

Planning and Programming

The planning and programming process develops and integrates the Program Objective Memorandum and maintains the Future Year Defense Plan (FYDP). These documents authorize the services to both carry out and budget each specific activity. The director of program and evaluation under the Air Force Chief of Staff oversees the planning and programming process.[4]

The planning function within the Pentagon begins with the submission of the POMs from the major commands. These inputs assist the Chiefs of Staff and the Service Secretaries in advocating their positions and developing Defense Planning Guidance (DPG). The latter is a high-level document that sets the stage for apportioning resources among the services and within various mission areas. After the DPG is issued, the major commands update their POMs based on the expected allocations among services and mission areas.

The programming function takes the updated POMs and develops a consolidated program outline of all Air Force activities. This program is then worked through an elaborate process to ensure that it fits within the expected budget and program guidelines directed by Office of the Secretary of Defense, and that it meets the requirements of the senior Air Force leadership. The elaborate process used to make these decisions and tradeoffs is known as the enhanced Air Force corporate process, and includes over 70 separate weapon teams, 10 mission area panels, and 3 additional levels of review; before it is submitted and approved by the Chief of Staff and the Secretary of the Air Force. This entire process involves the participation of a significant number of people in the Pentagon.

The secretary of defense then approves a program decision memorandum, which outlines the proposed programs for the services. This memorandum forms the basis for the Future Years Defense Program (FYDP), which outlines the path for the military services over the next six years. The program decision memorandum is then submitted to committees in Congress for their authorization.

The Enhanced Air Force Corporate Process

The enhanced Air Force corporate process includes five levels of review within the Pentagon prior to the final review by the Chief of Staff and the Secretary of the Air Force. It is intended to provide the senior leadership with the "corporate position while retaining the responsibilities of the functional organizations." In other words, the "corporate position" is a negotiated result and compromise solution on the funding levels for various Air Force activities between the organizations and personalities represented within the various panels, board, groups, and council.

The different levels of review are described below and depicted in Figure 9. In 1997, development and procurement activities represented 32 percent of the total Air Force budget.

Integrated process teams (IPT) are staffed by the various program element monitors and action offices associated with a weapon system. The IPT is the single point of contact for the major commands to specific programs. There are roughly 70 separate weapon system IPTs.

Mission and mission support panels serve as the Air Force "centers of expertise" and represent the first level of corporate review within each of 10 mission areas. While retaining a corporate or Air Force-wide perspective, the panels must still play the role of advocate for a particular project within the corporate process.

[4] HQ USAF/PE was recently placed under HQ USAF/XO to create HQ USAF/XOP.

The Air Force Group undertakes the first integrated Air Force-wide review and consists of 23 core members and 7 members representing the functional areas of the Air Force. During the POM process, this group is empowered with "off-the-table" decision authority (they can say no to a decision, but not yes) as the AF Group brings ideas forward to the Air Force Board.

The Air Force Board is a two-star-level review staffed by the deputies of senior leaders in each major functional area. The board now consists of 23 core functional areas and 7 other members.

The Air Force Council, a three-and-four-star level review, consists of senior leaders from the various functional areas and major commands. The council provides recommendations that are coordinated at senior levels across the Air Force and forwarded to the Air Force Chief of Staff and the Secretary of the Air Force.

Budgeting

The Air Force budget process is organized and controlled primarily by the Assistant Secretary of the Air Force for Financial Management, and more particularly by the budget division. The annual budget is developed based on the results of the Program Objective Memorandum. The budgeting process develops more accurate estimates of the costs of executing approved activities by updating previous estimates using current prices, inflation estimates, and economic forecasts. The budgeting process also separates the required funds into categories used to submit the overall Air Force budget estimate and compose the President's Budget to Congress.

Based on these estimates and changes as directed by guidance from the Secretary of Defense, the Air Force Corporate Process Structure reworks the Air Force program to create the budget estimate submission (BES). The BES represents the Air Force input into the annual DoD budget request. Following a review by the Office of the Secretary of Defense and the Office of Management and Budget, the Secretary of Defense issues a President's Budget Decision (PBD). The services again adjust their program to comply with the PBD and finalize the Air Force budget. The President's Budget is then submitted to Congress for approval and enactment.

Once the budget is passed by Congress and signed by the president, the budget and comptroller communities distribute funding and track expenditures to ensure that no money is spent that is not allocated and appropriated for a specific project.

The outcomes of this entire process--Program Objective Memorandum and the Future Years Defense Program -- are inputs into the acquisition processes and critical to a product development effort. With the added expectation of an approved Operational Requirements Document, the steps typically associated with the acquisition processes begin. Participants in the acquisition processes take the users' requirements and expected resources and develop an acquisition plan, select a contractor, and develop the product and the manufacturing process.

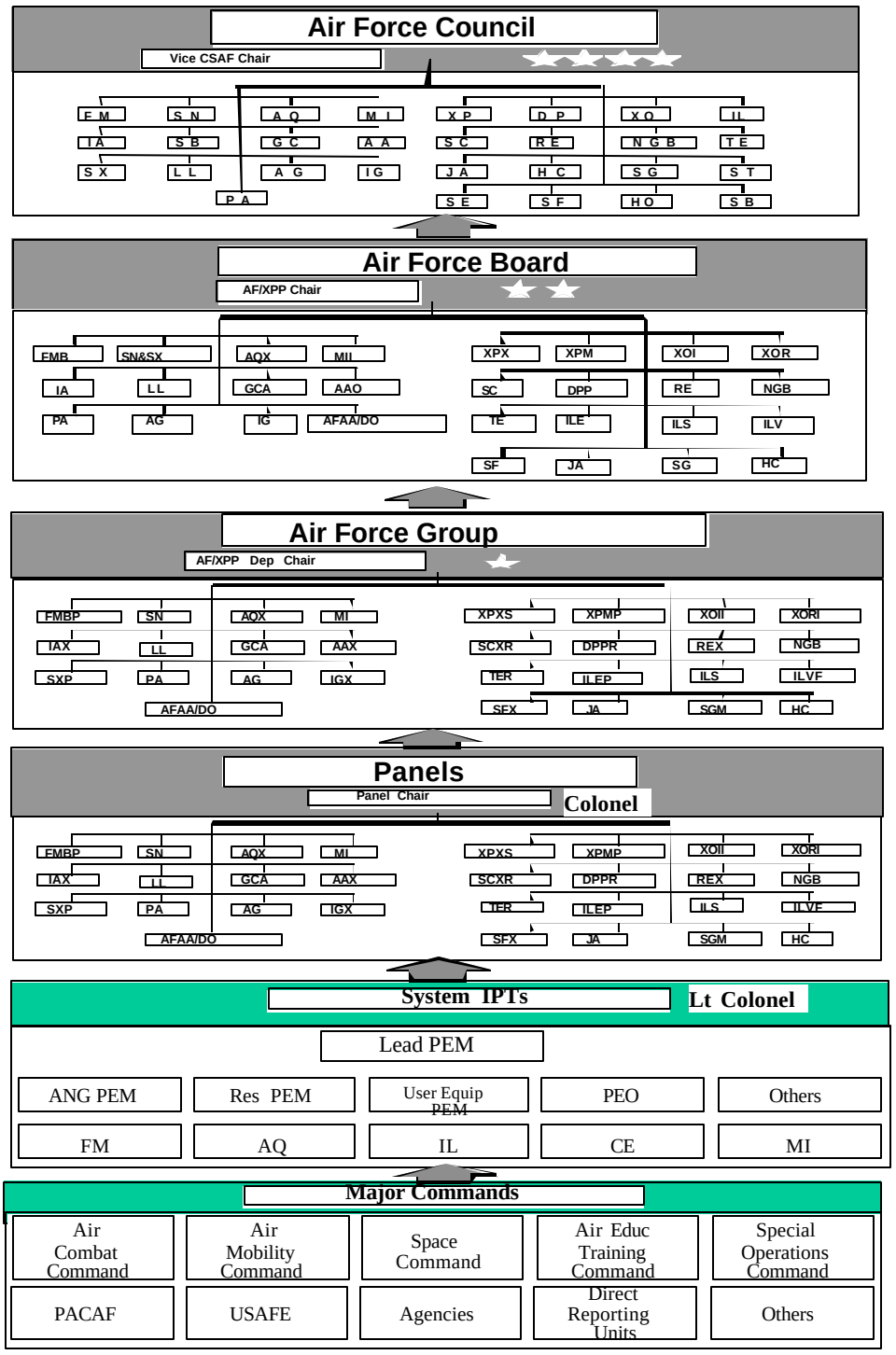

Figure 9: The Enhanced Air Force Corporate Review Process.[5]

[5] Developed from USAF Document "The Planning, Programming, and Budgeting System & The Air Force Corporate Structure (AFCS) Primer, 9th Edition." AF/XPPE. May 1998.

F. Acquisition Planning and Approval

In the acquisition approval and milestone decision processes, the service headquarters and service acquisition executive review the proposed plans and decide if the project can proceed to the next stage.

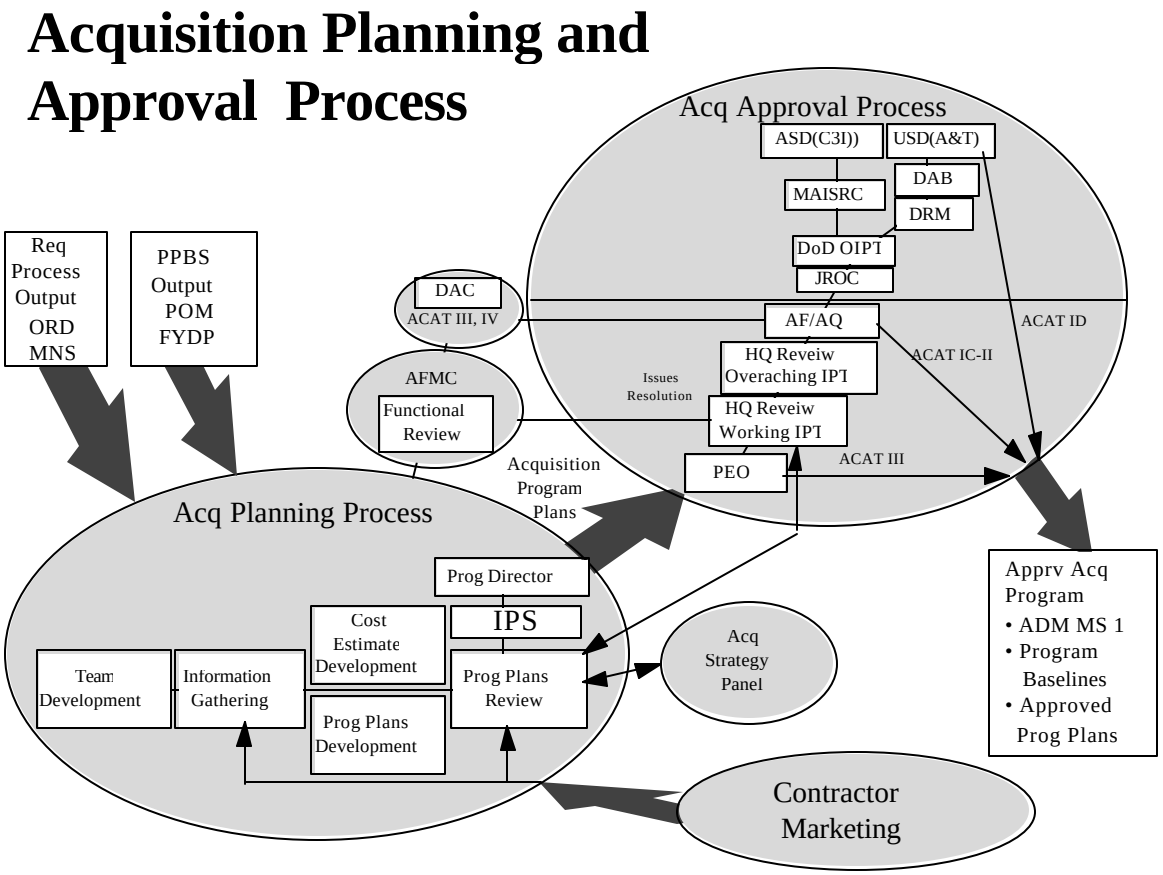

Figure 10: Acquisition Planning and Approval Processes

Acquisition Strategy Report	Description of Data Requirements
Acquisition Program Baseline	Exit Criteria
Affordability Assessment	Independent Estimate of Life-Cycle Costs
Future Years Defense Program Funding Profile	Operational Requirements Document
Analysis of Alternatives	Program Office Life-Cycle Cost Estimate
Component Cost Analysis	System Threat Assessment Report
Cost Analysis Requirements Description	Test and Evaluation Master Plan

Table 1: Information Required for a Milestone I Decision for Major Defense Acquisition Programs

F.1. Acquisition Planning

This process develops plans based on the users' Operational Requirements Document. The major acquisition planning steps include developing a team, collecting information, creating program plans, projecting costs, and developing an acquisition strategy. The major products are acquisition plans, cost estimates, proposed project schedules, and a proposed acquisition program baseline that outlines the project's cost, schedule, and performance objectives.

The planning effort is accomplished by a newly formed Program Office specific to the project, or by a team within an existing Program Office. The Program Office typically surveys potential contractors to understand abilities and technologies available to the project. From this information, the Program Office develops a series of plans that outline how, when, and at what cost the project can proceed. The plans typically include an acquisition plan, a source selection plan, and system engineering plans including a work breakdown structure, a master plan and a master schedule. The plans also include an integrated logistics support plan; a test and evaluation master plan; a human system integration plan; and a threat assessment report. These plans and reports cover the entire expected life of the program, not just the development effort. During this phase, the Program Office develops detailed cost estimates showing that the plans are affordable within the expected resources, as required for a Milestone I decision. The reports officially required for a Milestone I decision for major defense acquisition programs are shown in Table 1.

When the plans are complete, the Program Office holds an acquisition strategy review with a panel of outside experts and consolidates the results into an integrated program summary. This summary is signed by the program director and forwarded to the Pentagon for review and approval.

F.2. Acquisition Approval

Milestone approval is the formal process used to review projects and authorize them to proceed to the next acquisition phase. Formal milestone decisions are required by Defense Acquisition Directive 5000.1, which gives the Defense Acquisition Executive and Service Acquisition Executives the milestone decision authority for major programs. For smaller programs the product center commanders, also known as Defense Acquisition Commanders (DACs), have milestone decision authority. Milestone decisions are intended to ensure that all essential issues are addressed prior to approval for the program to proceed. After a Milestone I decision initiates a formal acquisition program, a Milestone II decision authorizes full-scale development, and a Milestone III decision authorizes full-rate production.

Before a milestone decision, a project must pass through a series of Pentagon reviews. Each major organization involved with any aspect of the development program is represented on two respective teams: the Working-Level Integrated Product Team (WIPT), and the Overarching Integrated Product Team (OIPT). The people and organizations involved with these teams overlap significantly with the earlier integrated product teams that allocated resources.

These committees are intended to resolve all issues before submitting the entire package to the Air Force System Acquisition Review Council and the Assistant Secretary of the Air Force for Acquisition for final approval. The largest programs are reviewed in the Office of the Secretary of Defense, by the Joint Requirements Oversight Council, the DoD-level Overarching IPT, and the Defense Acquisition Board prior to approval by the Under Secretary of Defense for Acquisition and Technology.

A Milestone I decision yields a signed acquisition decision memorandum authorizing a formal acquisition project and a baseline specifying cost, schedule, and performance. Deviations from the approved requirements or the acquisition strategy require similar approval from the milestone decision authority. An approved Milestone I decision allows the program office to start the contracting processes.

G. Contracting

Contracting is a critical part of the development process. The basic contracting process is dictated by federal acquisition regulations and applies across all federal agencies. Its two primary purposes are to select a contractor, and to agree on terms and conditions for the contract. Contracting can be separated into three periods: planning for release of the request for proposal, the period in which the contractors develop their proposals and selection of a contractor and award of a contract by the Program Office.

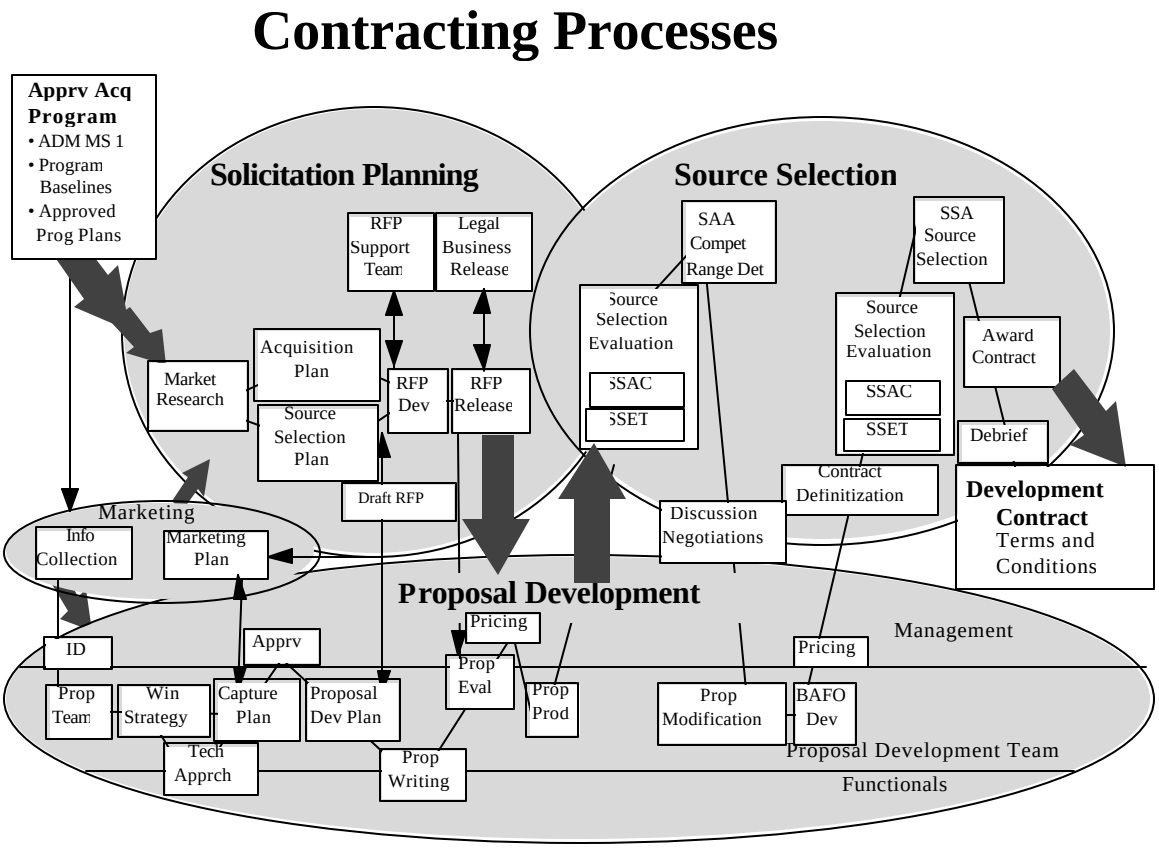

Figure 11: The Contracting Process.

G.1. Solicitation Planning

The many-step process of planning the solicitation overlaps significantly and is often indistinguishable from some of the early acquisition planning processes. One early step is market research to identify potential contractors. The solicitation planning stage also includes developing the acquisition plan, which schedules the contracting steps and specifies the requirements for the solicitation.

This phase also spells out the process to be used to select the winning contractor, including the evaluation criteria and the specific weights assigned to each. The criteria and the relative weighting are provided to the contractors as part of the request for proposals. The source selection criteria cannot be changed after the request for proposals is issued, to prevent manipulation.

A major part of solicitation planning is developing the formal document that tells contractors what the government requires and how the contractors are to respond. Contractors are typically asked to comment on the RFP while it is in draft, to identify particularly onerous or costly requirements.

The first part of the RFP typically includes a model contract and the procedures and ground rules for selection. The second part describes the procedures and ground rules to be followed in the proposal, the basis for selection, and the specific information needed to make the selection. This section usually asks for technical, management, and price or cost proposals detailing various aspects of a contractor's proposed development effort. All Air Force RFPs are reviewed by the centralized RFP support team to ensure that the requests do not tell contractors how to do things but instead simply state the objectives.

As part of solicitation planning, the Program Office develops detailed cost estimates for the proposed contracts it is requesting. This helps ensure that the Program Office is not requesting more development effort than it can afford, and is used to select and negotiate with the contractors.

Each step in the solicitation planning process undergoes legal review to ensure that it adheres to appropriate laws and regulations. The final review is a business release that allows the RFP to be issued. The solicitation planning phase ends when the Program Office releases the request for proposals, after which no informal discussion between industry and the Program Office is allowed, to prevent favoritism. The next process entails development by the contractors of a proposal.

G.2. Proposal Development

For defense contractors, winning the source selection process is the most important aspect of their business. Because a single contractor usually develops, produces, and maintains defense systems, not being selected at any point in the process will often eliminate a company from the entire market. Defense contractors therefore place great emphasis on their ability to develop proposals and their responsiveness to customers. The following description is based on a number of industry guidelines for developing proposals, interviews with industry participants in the Lean Aircraft Initiative, and a course run by the Educational Service Institute that teaches government personnel source selection procedures.[6]

Proposal development and marketing activities begin long before release of the RFP—and indeed even before the Program Office establishes a project. Companies often propose solutions to needs directly to users, the Pentagon, and the Program Offices in an attempt to initiate contracts they can easily win. One primary function of companies' marketing divisions is to identify upcoming projects that fit within the company's product line. Marketing divisions seek information such as the budget for potential projects, their sponsors and their interests and concerns, and the concerns of the Program Office leaders. One objective is to slant specifications and source selection criteria toward the company's approach. Marketing divisions also identify potential competitors, their likely approaches, and their level of interest in the project. Early market research ensures that a company has adequate time and the necessary information to develop an effective proposal, as companies often submit their proposals right after the legal minimum of 30 days following release of the RFP.

When a company identifies a project that the firm stands a significant chance of winning, it establishes a proposal development team. This initial team evaluates the information from marketing and develops a strategy for winning the contract. After consulting with engineering groups, the team selects the best technical approach and develops a "capture plan" detailing and coordinating the company's efforts to win the contract. The capture plan includes a marketing plan and a proposal development plan. The marketing plan ensures that the Program Office is fully informed--and hopefully convinced--of the benefits of the company's specific approach. Marketing efforts also ensure that the proposal addresses Program Office concerns, and the contractor's internal proposal evaluation ensures that the proposal has met all RFP requirements and provides specific answers to fulfill the criteria. The capture plan is presented to senior management for their approval.

According to industry proposal training material, "the proposal is primarily a selling tool designed to stress customer objectives and customer benefits, while stating the customer's problem in his terms and

[6] The description is obtained primarily from two company proposal development guides for which documentation was obtained. The companies requested not to be identified. Interviews with other industry representatives supported the statements contained in the guides. The process described is similar to the process outlined in an Educational Services Institute course on source selections.

presenting the solution in a clear and straight forward manner." The guidelines stress that "the proposal is not the place to tell the government it is wrong. . . [That] is not a winning strategy." Instead, a company often portrays alternative approaches by other firms as inferior, to make the strongest case for its approach. Many companies also create groups that solely prepare or assist in preparing proposals, led by a proposal manager and a proposal development specialist. The proposal manager often becomes the program manager if the company wins the contract.

Proposals are typically written in sections, each targeted to different evaluators on the source selection team. Those elements, which typically include an executive summary, the technical approach, the program plan, and the management plan, are expected to stand alone. The program plan and the technical approach require creation of a work breakdown structure and the systems engineering management plan.

Companies often have the option of submitting an alternative proposal that presents a program different from the one the government has requested. Such proposals may not meet all the government's requirements but may showcase an innovative approach to meeting users' needs. However, according to the Aeronautical Systems Center Pre-Award Support Office (a group that helps many program offices develop requests for proposals and run source selections) contractors take this route only rarely.

After drafting and evaluating the proposal, company management sets the price it will bid. Managers base this decision on cost estimates developed by the proposal team, evaluation of potential competitors' strategies, and the importance of winning the project. Once the final price has been set, final proposal production occurs. Submission of contractors' proposals begins the source selection process.

G.3. Source Selection

Before beginning source selection, a Program Office writes a plan that specifically describes the process to be used to evaluate the proposals. The Source Selection Authority approves this plan before release of the RFP.

The selection process typically includes a Source Selection Evaluation Board (SSEB) composed of several panels that evaluate different aspects of each proposal; a Source Selection Advisory Council (SSAC); and a Source Selection Authority (SSA). The SSEB is solely responsible for evaluating the proposals against the set standards--it does not evaluate different proposals against each other. The Source Selection Advisory Council, composed of senior military and government personnel, reviews the SSEB finding, compares the proposals, and considers contractors' past performance. This committee makes a recommendation to the Source Selection Authority, which then selects the competing contractors with which DoD will negotiate. The committee can pursue a contract without negotiations by choosing one of the original proposals unmodified.

Negotiations further refine and clarify the contractors' proposals to better meet the expectations and concerns of the Program Office. Care must be taken to provide all competing contractors with similar information but not to share proprietary information. Companies then modify their proposals and develop their "best and final offer." During this period a proposed formal contract between the Program Office and the contractor, specifying which aspects will be made legally binding and under what conditions, is written and prepared.

Using the contractor's best offer and the finalized contract, the Source Selection Authority can choose either the best-value proposal or the lowest-cost technically acceptable proposal. Decision makers may ignore the scores, re-score the proposals, or declare differences insignificant, but the selection is susceptible to protest and judicial review. While protests occur frequently, few are upheld. Of the 47 protests in 1995, for example, only 2 were upheld.[7] The Air Force often goes to great lengths and expense to ensure that the source selection is "fire-proof" and can withstand a protest.

Following the source selection decision, the Program Office can award the contract and development can begin.

[7] Lt Gen Franklin's Briefing to Industry Day at Electronic Systems Center. Hanscom AFB MA. March 1996.

H. Developing the Product and Process

Development of the actual product and the process used to make it is conducted primarily by the contractors. The contractors' development activities are overseen by the Program Office, to identify problems early on. The Pentagon oversees the activities of the Program Offices and the contractors, to alert senior leaders to problems. A process is also available to modify the contract and requirements to adapt to unforeseen events.

H.1. Product and Process Development

Contractors themselves can determine how best to develop a product and the process used to make it, as long as they remain within the bounds of the contract. Contract specifications can be extensive if they include the system engineering management plan and work breakdown structure. A company's development efforts typically follow standard system engineering approaches, with a series of internal reviews, tests, and audits as a design matures. Many of the company's activities are driven by program oversight requirements.

Contractors receive progress payments throughout development. The amount is determined by the cost work breakdown structure and its packages as described in the contract and as measured through the company's cost/schedule control system (C/SCS), which the companies keep in accordance with DoD accounting requirements. Contractors' requests for payment are certified by the Program Office and sent to the Defense Finance and Accounting Service.

H.2. Development Oversight

The development oversight process involves two distinct levels: program oversight of the defense contractor, and Pentagon oversight of the Program Office. Each is intended to ensure that the proper actions are taken, and that the development of the desired product is proceeding within the technical and cost parameters.

Program Office Oversight of the Contractor

To ensure progress towards completing the design, and a design that will meet the requirements, the Program Office conducts periodic reviews of both the design and its financial performance. These reviews offer insight into the technical aspects of the development process and allow for early identification of potential problems. Progress is measured against the company's planned or contracted schedule.

The Program Office performs financial oversight through the cost/schedule control system, which formalizes periodic reports indicating the funds spent by the contractor and the amount of work accomplished. From these reports the Program Offices can determine the budgeted cost of the work performed, the actual cost of the work performed, the budgeted cost of the work scheduled, and the estimated cost at completion. These are used to determine if the contractor is meeting the schedule and cost estimates established in the contract.

Pentagon Oversight of the Program Offices

Pentagon oversight of the Program Office and the contractor is more limited than Program Office oversight of contractors. Pentagon oversight is often dependent on Program Office reporting. Quarterly reports are due from all major defense acquisition programs as part of the defense acquisition executive summary (DAES), completed by the Office of the Secretary of Defense. Smaller programs are subject to reviews by their respective program executive officer or product center commander. (Each Development Center and Program Executive Office also conducts an annual portfolio review with the senior acquisition executive to review the breadth of projects.)

Test results and completion of major milestones on schedule indicate that the technical aspects of a program are likely under control. Missed milestones or failed tests indicate that there may be problems and often provoke greater Pentagon scrutiny and oversight. A final operational test and evaluation (OT&E) follows completion of the development effort and precedes full-rate production. OT&E tests the system against the operational requirements document and provides an independent assessment of the development effort.

H.3. Change

During development effort requirements may change, the contract may change, and annual funding may change. These changes may be directed by the Pentagon or the users, or they may come from the contractors. Changing established program plans is difficult for both DoD and contractors.

Revisions in the annual projected budget are one of the major sources of change in defense programs. When the allocated budget is changed, the Program Offices must adapt to the often lower level of funds, and the contract must often be re-negotiated. Additional requirements based on changing circumstances, or the availability of newer technology, may also change users' desired capabilities.

Bottom-up changes are often the result of problems within a development effort. The inability to meet cost, schedule, or technical performance requirements often force a contractor and a program office to suspend requirements, increase funding, or to delay the product. These changes often require a significant amount of effort to obtain agreement from the Pentagon organizations that must review and approve them. Such changes must follow a similar path as the original approval process, as must requests for additional funding, which must also compete with other projects. What's more, changes to the acquisition program baseline require a similar level of review as the original milestone decision process. Surmounting these hurdles requires considerable effort and attracts greater scrutiny to a project.

Summary

The Air Force product development process described is a complicated and elaborate process. The major players in the development process include the major commands, the various Pentagon organizations, the program offices, and the defense contractors. The earliest development processes includes many processes from the modernization planning process, to the mission needs process, to the requirements generation and approval processes. The planning, programming, and budgeting system as implemented by the Air Force through its corporate process is an very elaborate process encompassing 6 layers of review multiple times per year. The acquisition processes include the acquisition planning and approval process, the contracting process and the contractor oversight process. Many of the processes involve multiple levels of reviews within the Pentagon and major commands. Each of these processes is currently required to develop a project. While the Air Force product development process may be slightly more complicated than those of the other services, the basic steps are similar.